Aviation

Pensacola
Pre-flight school

STUDENT BODY OF THE NAVAL SCHOOL, PRE-FLIGHT
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PRE-FLIGHT STUDENT PENSACOLA SPEECH

I HAVE LOOKED FORWARD FOR SOMETIME TO THIS OPPORTUNITY TO VISIT THIS MAGNIFICENT COMPLEX WHOSE FUNCTION IT IS TO TRAIN CAREFULLY SELECTED YOUNG MEN IN THE VERY COMPLICATED AND INTRICATE PROCESS OF OPERATING HIGH PERFORMANCE AIRCRAFT. IN SEARCHING MY MIND AND MY EXPERIENCES OF SOME THIRTY-FIVE YEARS OF NAVAL SERVICE TO DEVELOP SOME THOUGHTS WHICH MIGHT BE APPROPRIATE AND OF INTEREST TO THIS GROUP, I FELT THAT PERHAPS SOME SORT OF A CHRONOLOGY MIGHT BEST PORTRAY THE EXCITING AND SOMETIMES UNBELIEVEABLE EVENTS WHICH HAVE OCCURRED IN AVIATION AND SPACE EXPLORATION. I KNOW THIS AUDIENCE WOULD EXPECT ME TO RELATE THE CONTRIBUTIONS WHICH BIOMEDICAL RESEARCH AND THE SCIENCE OF MEDICINE HAS MADE TO MANNED AIR AND SPACECRAFT. AS YOU ACQUIRE THE ART OF FLYING AND BECOME MORE FAMILIAR WITH THE AIRCRAFT AND PERSONAL EQUIPMENT, I THINK YOU WILL RECOGNIZE THE MANY INTERFACES BETWEEN AIRCRAFT DESIGN AND HUMAN ENGINEERING WHICH DETERMINE BOTH MAN'S CAPABILITIES AND HIS LIMITATIONS.

FIRST, LET ME TALK BRIEFLY ABOUT THE KIND OF AN OUTFIT YOU HAVE JOINED. YOUR VERY PRESENCE HERE CERTAINLY IS EVIDENCE THAT, FOR ONE REASON OR ANOTHER, YOU HAVE SELECTED THE NAVY AS THE MILITARY SERVICE OF YOUR CHOICE AND WITHIN THAT SERVICE YOU HAVE AMBITIONS TO SPECIALIZE IN NAVAL AVIATION. I SUSPECT ALL OF YOU HOPE TO BE CONVINCED WHILE YOU ARE HERE THAT YOU HAVE MADE A WISE CHOICE - A CHOICE THAT WILL NOT ONLY PERMIT YOU TO SATISFY A PERSONAL DESIRE BUT WILL PROVIDE A PLACE ON A TEAM WHICH IS FULL OF THE TRADITIONS OF THE SEA AND RIGHTLY PROUD OF ITS CONTRIBUTIONS TO THE DEFENSE

AND FREEDOM OF THIS COUNTRY; A TEAM COMPOSED VERY MUCH OF PEOPLE LIKE YOURSELF BUT WITH THAT ADDED PROFESSIONAL CONFIDENCE THAT COMES FROM YEARS OF TRAINING AND EXPERIENCE AND LEADERSHIP QUALITIES DERIVED FROM PERSONAL CHARACTER AND THE ABILITY TO CREATE IN OTHERS A DESIRE AND EFFECTIVE EFFORT TO PERFORM TO THE MAXIMUM OF THEIR ABILITY.

I KNOW OF NO BETTER EXAMPLE OF THESE QUALITIES TO WHICH I HAVE REFERRED THAN YOUR COMMANDER OF NAVAL AIR BASIC TRAINING AND MY GOOD FRIEND, REAR ADMIRAL DANIEL F. SMITH. A SHORT PERIOD OF HIS WORLD WAR II EXPLOITS ARE VIVIDLY DESCRIBED BETWEEN PAGES 362 AND 419 OF THE FASCINATING STORY OF THE USS ENTERPRISE "THE BIG E" BY COMMANDER EDWARD P. STRAFFORD, USN. ALTHOUGH AIR GROUP 20, WITH DAN SMITH AS THEIR COMMANDER, SPENT BUT THREE MONTHS ABOARD THE USS ENTERPRISE BEFORE TRANSFERRING TO THE USS LEXINGTON AT ULITHI ON 23 NOVEMBER 1944, THOSE THREE MONTHS ENCOMPASSED ONE OF THE MOST INTENSIVE PERIODS OF AERIAL WARFARE IN THE PACIFIC - BEGINNING WITH THE RAIDS ON THE BONINS AND PALAU AND EXTENDING THROUGH THE AMPHIBIOUS LANDINGS IN LEYTE GULF TO THE MAJOR NAVAL BATTLES IN WHICH THE JAPANESE SUFFERED LOSSES FROM WHICH THEY NEVER RECOVERED. BOMBERS AND TORPEDO PLANES OF AIR GROUP 20 ATTACKED THE STRONG FORCE OF MAJOR JAPANESE WARSHIPS INCLUDING THE SUPER BATTLESHIPS YAMATO AND MUSASHI. THESE SHIPS WERE CONSIDERED INDESTRUCTIBLE BY THE JAPANESE BECAUSE OF THEIR HEAVY ARMOR AND ARMAMENT. HOWEVER, THE ACCURACY OF AIR GROUP 20 PILOTS, UNDER COMMANDER DAN SMITH'S DIRECTION, RESULTED IN SUCH A RAIN OF BOMB AND TORPEDO HITS THAT THE MUSASHI WENT DOWN BY THE BOW WITHIN TWO HOURS.

THE MULTI-FACETED ACTIVITIES OF TODAY'S MODERN NAVY GIVE REALISTIC MEANING TO THE PHRASE "SEA POWER". AS AN INSTRUMENT FOR PROJECTING NATIONAL POLICY OR SUSTAINING NATIONAL DEFENSE THE STRENGTH OF THE UNITED STATES NAVY RENDERS IT A POTENT MEMBER OF THE DEFENSE TEAM. THE ABILITY TO CONTROL THE SEA AS A MEDIUM FOR THE CONDUCT OF SUBMERSIBLE OPERATIONS, SURFACE MANEUVERS AND SHIP-LAUNCHED AIRCRAFT CREATES A VERSATILITY PROBABLY UNMATCHED IN THE CONFINES OF FIXED LAND MASSES. ADD TO THIS POWER 190,000 UNITED STATES MARINES TRAINED IN AMPHIBIOUS ASSAULT WITH AIR AND SEA SUPPORT, AND YOU HAVE A SERVICE CAPABLE OF PROVIDING A WIDE VARIETY AND COMBINATION OF MILITARY FORCES AT THE DISCRETION OF THE COMMANDER IN CHIEF.

ALTHOUGH I AM NOT A NAVAL AVIATOR, I BELIEVE I CAN FEEL WITH YOU SOME OF THE FACTORS WHICH HAVE MOTIVATED YOU TO SEEK FLIGHT TRAINING AND POSSIBLY ULTIMATELY A CAREER IN NAVAL AVIATION. FOR SOME OF US WHO GREW UP ON THE FARM OR IN SMALL TOWNS IN THE DAYS OF THE HORSE AND BUGGY OR THE EARLIER AUTOMOBILES OR THE RAILROAD, WE MAY HAVE TENDED TO GO MORE THROUGH THE STAGES OF THRILL AND EXCITEMENT CONNECTED WITH WANTING TO BE A FIREMAN, A POLICEMAN, A RACING DRIVER, OR STEAM LOCOMOTIVE ENGINEER. IN YOUR GENERATION AS GROWING BOYS, THIS THRILL AND EXCITEMENT OF POSSESSION AND CONTROL OF POWER HAS BEEN MULTIPLIED MANY FOLD WITH THE PROGRESSIVE DEVELOPMENT OF AIRCRAFT. ALTHOUGH THE SPEED AND ALTITUDE CAPABILITIES OF THE AIRPLANE GREW RELATIVELY SLOW DURING MOST OF THE FIRST HALF CENTURY OF ITS EXISTENCE, THE STIMULUS OF WORLD WAR II, AND THE DEVELOPMENT OF THE JET AND ROCKET ENGINES, ALONG WITH GREATLY IMPROVED AND MODIFIED AIRCRAFT AND LATER SPACE VEHICLE

DESIGN HAVE MANIFOLDLY WIDENED THE HORIZONS.

I WOULD SUPPOSE THAT MOST OF YOU HAVE GIVEN VARIOUS DEGREES OF THOUGHT AS TO WHY YOU CHOSE TO SEEK TRAINING IN NAVAL AVIATION. CERTAINLY IT WOULD BE THE RARE INDIVIDUAL WHO WOULD HAVE A SINGLE MOTIVATION. FURTHERMORE, WITH MOST OF US, OUR MOTIVATIONS MIGHT BE VERY COMPLEX AND NOT ALWAYS ENTIRELY CLEAR TO US. SERVICE TO ONE'S COUNTRY, ACHIEVEMENT, STATUS, A SATISFYING PROFESSION - MIGHT BE MORE GENERAL GOALS. POSSIBLY MORE IMMEDIATELY YOUR THOUGHTS OR FANTASIES MIGHT TURN TO GOALS INVOLVING CURIOSITY IN CONQUERING AN UNKNOWN ENVIRONMENT, OR AS THE BRITISH MOUNTAIN CLIMBER, GEORGE LEIGH MALLORY ONCE REPLIED, WHEN ASKED WHY HE WANTED TO CLIMB MOUNT EVEREST, "BECAUSE THE MOUNTAIN IS THERE." INHERENT IN THIS REPLY IS A CHALLENGE TO ADVERSITY, CONSTRUCTIVE AGGRESSION IN ACHIEVING A DIFFICULT GOAL, ACHIEVING A SENSE OF FREEDOM, INDEPENDENCE AND OMNIPOTENCE FOR WHICH MAN'S NATURE HAS ALWAYS STRUGGLED, COUPLED WITH DEFIANCE OF GRAVITY, REBELLION AGAINST EARTH-BOUND LIMITATIONS, MASTERY OF ONE'S ENVIRONMENT, AND YES, EVEN BEYOND OUR ENVIRONMENT TO SPACE, THE MOON AND ULTIMATELY POSSIBLY OTHER PLANETS.

HOWEVER, TO RETURN FROM THE AIR SPACE TO EARTH AGAIN, YOU HAVE AT THIS STAGE OF YOUR CAREERS, A GREAT CHALLENGE AND AN UNSURPASSED OPPORTUNITY TO LEARN MANY WONDERFUL THINGS.

MEDICAL SCIENCE IS PROUD TO HAVE PLAYED ITS PART IN THE EXTENSION OF MAN'S HORIZONS IN FLIGHT IN AIR AND SPACE THROUGH RESEARCH INTO MAN'S LIMITATIONS TO HIGH ALTITUDE, ACCELERATION,

TEMPERATURE EXTREMES, DISORIENTATION AND THE DEVELOPMENT OF INSTRUMENTATION, PROTECTIVE EQUIPMENT AND OF EMERGENCY SAFETY, ESCAPE AND SURVIVAL EQUIPMENT TO CONTROL THESE EXTREME OR UNUSUAL CONDITIONS.

AS YOU GO THROUGH TRAINING YOU WILL LEARN MORE OF THE IMPORTANCE OF UNDERSTANDING MAN'S LIMITATIONS AND THE PROPER AND NECESSARY USE OF AIRCRAFT INSTRUMENTATION, OXYGEN EQUIPMENT, ANTI-G SUITS, EJECTION SEATS, HIGH ALTITUDE PRESSURE SUITS, THE PRINCIPLES OF NIGHT VISION AND RESPECTIVELY THE RELATED PROBLEMS OF DISORIENTATION AND VERTIGO, INADEQUATE AMOUNTS OF ATMOSPHERIC OXYGEN, HIGH ACCELERATION OR "G" FORCES AND LOWERED BAROMETRIC PRESSURES.

NAVAL AVIATION MEDICINE, WITH THE UNIQUE EQUIPMENT HERE AT PENSACOLA, AT THE NAVAL AIR DEVELOPMENT CENTER AT JOHNSVILLE, PENNSYLVANIA, WITH THE WORLD'S LARGEST HUMAN CENTRIFUGE AND THE NEARBY AEROSPACE CREW EQUIPMENT LABORATORY, HAS MADE MAJOR CONTRIBUTIONS IN PERSONAL PROTECTIVE EQUIPMENT, INCLUDING THE ANTI-G SUIT, THE FULL PRESSURE (SPACE) SUIT, THE EJECTION SEAT AND COCKPIT CAPSULE AND RELATED RECOVERY SYSTEMS, SURVIVAL EQUIPMENT, NOISE PROTECTIVE DEVICES, THE SUPINE SEAT AND RELATED INDOCTRINATION PROGRAMS AND TRAINING DEVICES.

BUT NOW BACK TO THE MAIN THEME OF MY DISCUSSION THIS AFTERNOON. THE BIBLE TELLS US THAT GOD CREATED MAN, THE BIRDS OF THE AIR AND THE FISHES OF THE SEA. BUT MAN WAS NOT LONG CONTENT TO INHABIT ONLY THE EARTH. A FAMILIAR LEGEND OF AN EARLY ATTEMPT TO INVADE THE AIR-SPACE OF BIRDS COMES FROM ANCIENT GREECE. TO ESCAPE

IMPRISONMENT ON CRETE, DAEDAIUS AND HIS SON, ICARUS, FASHIONED WINGS WHICH WERE THEN FIXED TO THE SHOULDERS BY WAX. THINGS WENT WELL UNTIL THE ZEALOUS ICARUS FLEW TOO CLOSE TO THE SUN RESULTING IN A WING FAILURE AND A FALL INTO THE SEA. EXCEPT FOR JUMPING OR BEING PUSHED FROM A CLIFF, DURING THE MIDDLE AGES LITTLE PROGRESS WAS MADE TOWARD EXPLORING THE ATMOSPHERE UNTIL THE LATTER PART OF THE EIGHTEENTH CENTURY WHEN THE MONTGOLFIER BROTHERS BEGAN A SUCCESSFUL SERIES OF BALLOON ASCENSIONS IN FRANCE. BALLOONING BECAME A POPULAR SPECTATOR SPORT AND CONTRIBUTED TO THE EXCITEMENT OF THE CROWDS THROUGHOUT THE WORLD. HOWEVER, SCIENTISTS QUICKLY RECOGNIZED THE BALLOON AS A MEANS OF CONDUCTING EXPERIMENTS ON THE HUMAN EFFECTS OF ALTITUDE.

IN 1784, DOCTOR JOHN JEFFRIES, AN AMERICAN PHYSICIAN, MADE A BALLOON ASCENSION CARRYING A FEW SCIENTIFIC INSTRUMENTS TO STUDY THE PROPERTIES OF THE ATMOSPHERE. DURING THE FLIGHT HE DROPPED A WRITTEN MESSAGE TO A FRIEND. THIS NOTE, NOW IN THE SNELL MUSEUM OF PHYSICS AT AMHERST COLLEGE, WAS THE FIRST PIECE OF MAIL CARRIED BY AIR. IN 1785, DOCTOR JEFFRIES FLEW FROM DOVER, ENGLAND, TO NEAR CALAIS, FRANCE, ON A SECOND FLIGHT. IN 1786, HE WROTE A BOOK DESCRIBING HIS EXPERIENCES. DOCTOR JEFFRIES WAS THE FIRST AMERICAN TO FLY; THE FIRST TO PUBLISH A BOOK ON AERONAUTICS; THE FIRST TO STUDY SCIENTIFICALLY THE COMPOSITION OF THE UPPER AIR; THE FIRST TO CARRY AIR MAIL; AND THE FIRST TO MAKE AN AERIAL TRANSOCEANIC CROSSING. TO HONOR THIS FAMOUS AMERICAN PHYSICIAN, THE INSTITUTE OF AERONAUTICAL SCIENCES, IN 1940, ESTABLISHED THE

JOHN JEFFRIES AWARD WHICH IS PRESENTED EACH YEAR TO THE PHYSICIAN WHO MAKES THE GREATEST CONTRIBUTION TO AVIATION MEDICINE.

BALLOON ASCENSIONS FOR SCIENTIFIC STUDY CONTINUED SPORADICALLY UNTIL THE DISASTROUS ASCENSION IN 1875 OF TESSANDIER, DE SEVEL, AND CROCE SPINELLI. A MISCALCULATION AT AN ALTITUDE OF 24,000 FEET RESULTED IN THE ANOXIA DEATH OF SEVEL AND SPINELLI. THE 1930s SAW A RESURGENCE OF INTEREST IN THE LIGHTER-THAN-AIR ALTITUDE EXPLORATION WITH COLONEL DAVE SIMMONS REACHING AN ALTITUDE OF 102,000 FEET IN A SEALED PRESSURIZED CAPSULE. CAPTAIN JOE KILLINGER FOLLOWED WITH A SERIES OF FREE FALL JUMPS FROM INCREASING ALTITUDES FINALLY CULMINATING IN A WORLD RECORD FREE FALL OF 4 MINUTES-38 SECONDS FROM AN ALTITUDE OF 102,800 FEET. THE PRESSURE SUIT AND ANCILLARY EQUIPMENT DEMONSTRATED THAT MAN CAN BAIL OUT AT THAT ALTITUDE AND SURVIVE.

THE UNITED STATES NAVY WAS NOT INACTIVE IN THE USE OF BALLOONS. PROJECT STRATO-LAB AND THE MEDICAL RAM PROJECT BROUGHT LCDR MALCOLM ROSS AND MARTIN LEWIS INTO THE PICTURE. THE RECORD OF 113,740 FEET IS HELD BY COMMANDER ROSS AND THE LATE LCDR VICTOR PRATHER. THE RAM PROJECT CONDUCTED BY THE BUREAU OF MEDICINE AND SURGERY, UNDER APPROVAL AND SUPPORT OF THE OFFICE OF NAVAL RESEARCH, PIONEERED THE TECHNIC OF TELEMETERING PHYSIOLOGICAL DATA SUCH AS BODY TEMPERATURE, HEART RATE, THE ELECTROCARDIOGRAM AND RESPIRATION DURING ASCENSIONS INTO AN EXTREMELY HOSTILE ENVIRONMENT. PHYSICISTS AND PHYSIOLOGISTS WORKED VERY CLOSELY OFTEN AS CREW MEMBERS TO IDENTIFY THIS HOSTILE ENVIRONMENT AND EVALUATE MAN'S REACTION TO IT.

AS WE WILL DISCUSS LATER, MUCH OF THE FIELD TESTING OF THE PRESSURE SUIT IN FRIGID HYPO BARIC ATMOSPHERE WAS ACCOMPLISHED DURING THESE SCIENTIFICALLY ORIENTED BALLOON ASCENSIONS.

I AM CERTAIN THAT ORVILLE AND WILBUR WRIGHT WERE LITTLE CONCERNED ABOUT A HOSTILE ENVIRONMENT DURING THEIR EPOCHAL MANNED FLIGHT AT KITTY HAWK, NORTH CAROLINA, ON 17 DECEMBER 1903. THE FLIGHT, REACHING AN ALTITUDE OF LESS THAN 100 FEET AND CONTINUING FOR 59 SECONDS AT 30 MPH, WAS A CHALLENGE IN BECOMING AIRBORNE. THE PHENOMENAL PROGRESS IN AIRCRAFT DESIGN AND PROPULSION DURING THE SUCCEEDING YEARS, CULMINATING IN COLONEL JOHN GLENN'S ORBIT OF THE EARTH IN A VEHICLE UNDER HIS CONTROL, GAVE BIRTH TO AVIATION MEDICINE AS A PARTNER IN THE DEVELOPMENT AND OPERATION OF HIGH PERFORMANCE AIRCRAFT.

WHAT HAS HAPPENED IN NAVAL AVIATION WITHIN MY EXPERIENCE? IT WAS A SUNNY WARM DAY IN MAY 1933 WHEN I REPORTED TO THE NAVAL HOSPITAL HERE AT PENSACOLA FOR DUTY FOLLOWING TWO YEARS AT SEA ON DESTROYERS AND A BATTLESHIP. PENSACOLA WAS A DELIGHTFUL CITY OF SOME 35,000 INHABITANTS FULLY CONSCIOUS OF THE IMPACT THAT NAVAL AVIATION WAS HAVING ON THEIR ECONOMY AND WAY OF LIFE. IN FACT, PENSACOLA WAS KNOWN THROUGHOUT THE FLEET AS THE "MOTHER-IN-LAW" OF THE NAVY BECAUSE SO MANY STUDENT AVIATORS HAD MARRIED PENSACOLA GIRLS. ALL BASIC AND ADVANCED TRAINING WAS CONDUCTED AT THE MAIN STATION AND CORRY FIELD. THIS LATTER FIELD WAS CONSIDERED A BOLD STEP IN A SATELLITE FIELD AND WAS AT THAT TIME IN THE PROCESS OF REPLACING SOME REALLY PRIMITIVE

BUILDINGS WITH PERMANENT CONSTRUCTION. THE STUDENT AVIATOR WAS TAUGHT TO FLY IN SEAPLANES OF SQUADRON #1 LOCATED ALONG THE WATER FRONT AND THEN ADVANCED TO SQUADRON #2 AT CORRY FIELD. IT WAS HERE THAT THE STUDENT BECAME AWARE OF HIS ABILITY AND TEMPERAMENT TO CONTROL AIRCRAFT IN A VARIETY OF SITUATIONS INCLUDING SIMULATED EMERGENCIES DELIBERATELY CREATED BY HIS INSTRUCTOR. SQUADRON #5 WAS COMPOSED OF THE HOT CARRIER TYPE FIGHTER PLANES OF THE TYPE USED ON THE TWO NAVY AIRCRAFT CARRIERS, THE LEXINGTON AND THE SARATOGA. THESE INSTRUCTORS AND STUDENTS WERE THE SAME PILOTS WHO COMMANDED THE SQUADRONS ABOARD AN EVER-INCREASING NUMBER OF CARRIERS DURING WORLD WAR II WITH SUCH DEVASTATING AND EFFECTIVE ACTION AGAINST OUR ENEMY IN BOTH OCEANS.

THE KOREAN CONFLICT SAW THE FIRST OPERATIONAL JETS AND NOW WE HAVE THE HIGHLY INSTRUMENTED, SUPERSONIC, HIGH FLYING JETS.

THIS IS THE POINT WHERE MY STORY OF THE CHALLENGE TO HUMAN PERFORMANCE AND SURVIVAL BEGINS AND THE PART WHICH THOSE DEDICATED FLIGHT SURGEONS AND BIO-MEDICAL SCIENTISTS PLAYED IN MAKING IT POSSIBLE FOR PILOTS TO SAFELY ENDURE THE PHYSIOLOGICAL STRESSES WHICH ARE INHERENT IN THE TACTICAL FLIGHT PATTERNS OF TODAY'S HIGH PERFORMANCE AIRCRAFT.

FROM KNOWLEDGE GAINED BY MOUNTAIN TRAVEL, BALLOON ASCENTS, STUDIES OF CAISSON DISEASE AND THE SCIENTIFIC OBSERVATIONS OF SUCH MEN AS BOYLE, CHARLES AND THE FRENCH PHYSIOLOGIST, PAUL BERT, AVIATION MEDICINE HAD ITS ORIGINS. THE FULL EXTENT OF THE NEED FOR AVIATION

MEDICINE BECAME APPARENT EARLY IN WORLD WAR I WHEN IT WAS OBSERVED THAT NINETY PER CENT OF AIRCRAFT ACCIDENTS WERE DUE TO HUMAN FACTORS. MEDICAL SCIENCE SEEMS NOT TO HAVE BEEN CONCERNED WITH THE PROBLEM OF PILOT SELECTION UNTIL 1910 WHEN GERMANY ESTABLISHED MINIMUM PHYSICAL STANDARDS FOR MILITARY AVIATORS. IN 1912, FRANCE AND THE UNITED STATES ADOPTED SPECIAL REQUIREMENTS FOR MILITARY PILOTS. HOWEVER, THESE ATTEMPTS TO DEVISE SUITABLE PHYSICAL STANDARDS FOR FLYING WERE FORGOTTEN BY THE ALLIES IN THE FIRST YEAR OF THE WAR. NOT ONLY WERE UNSELECTED INDIVIDUALS PLACED IN FLIGHT TRAINING, BUT MEN UNFIT FOR THE GROUND SERVICES WERE FREQUENTLY ASSIGNED TO AVIATION. THE DISASTROUS RESULTS OF THIS PRACTICE SOON BECAME EVIDENT. DURING THE EARLY STAGES OF THE FIRST WORLD WAR, IT WAS REPORTED THAT SIXTY PER CENT OF THE BRITISH FLIGHT CASUALTIES WERE ATTRIBUTABLE TO PHYSICAL DEFECTS IN THE PILOT, THIRTY PERCENT TO OTHER HUMAN DEFICIENCIES, EIGHT PER CENT TO AIRCRAFT FAILURE AND ONLY TWO PER CENT TO COMBAT. WITH THE ADOPTION OF SEPARATE AND HIGHER PHYSICAL STANDARDS FOR AVIATORS, THE FIGURE OF SIXTY PERCENT CASUALTIES RELATED TO PHYSICAL DEFECTS WAS REDUCED TO TWELVE PER CENT WITHIN TWO YEARS.

IN THIS COUNTRY, THE STANDARDS PUBLISHED IN 1912 PROVED SO RIGID THAT NO ONE COULD PASS THEM. ACCORDINGLY, NEW STANDARDS WERE ESTABLISHED IN 1917. OVER HALF OF THIS NEW EXAMINATION WAS DEVOTED TO THE EYE AND THE EAR. ON THE NEW REPORTING FORM, ONLY ONE LINE WAS ALLOTTED TO THE NERVOUS SYSTEM.

IN 1917 AN AVIATION MEDICAL RESEARCH BOARD WAS APPOINTED TO: (1) INVESTIGATE ALL CONDITIONS WHICH AFFECT THE EFFICIENCY OF PILOTS; (2) INSTITUTE AND CARRY OUT SUCH EXPERIMENTS AND TESTS AS WOULD DETERMINE THE ABILITY OF PILOTS TO FLY AT HIGH ALTITUDES; (3) CARRY OUT EXPERIMENTS AND TESTS TO PROVIDE SUITABLE APPARATUS FOR THE SUPPLY OF OXYGEN TO PILOTS AT HIGH ALTITUDES; (4) ACT AS A STANDING MEDICAL BOARD FOR THE CONSIDERATION OF ALL MATTERS RELATING TO THE PHYSICAL FITNESS OF PILOTS.

THE FIRST ACTION OF THIS BOARD WAS TO ESTABLISH A MEDICAL RESEARCH LABORATORY AT HAZLEHURST FIELD, MINEOLA, LONG ISLAND. BY JUNE 1918, THE LABORATORY WAS IN FULL OPERATION. SUBSTANTIAL WORK WAS ACCOMPLISHED IN HYPOXIA; THE DEVELOPMENT OF AN ALTITUDE TOLERANCE TEST; AERIAL EQUILIBRATION AND ORIENTATION; AND REACTION TIME TESTS. OF HUMAN INTEREST, WAS THE DEVELOPMENT BY THIS LABORATORY OF MEDICAL TRAINING FILMS FOR PILOTS FEATURING PROBABLY THE FIRST ANIMATED CARTOONS. THE PRODUCER, MR. PAUL TERRY, LATER IN HOLLYWOOD, DEVELOPED THE NOW FAMOUS "TERRY TUNES". UNFORTUNATELY, AFTER WORLD WAR I, INTEREST IN AVIATION AGAIN LAGGED AND IN 1920, THE AIR SERVICE MEDICAL RESEARCH LABORATORY WAS ABANDONED.

MEANWHILE IN OCTOBER 1917, AN AMERICAN MEDICAL MISSION DEPARTED FOR EUROPE TO STUDY AVIATION MEDICINE IN ENGLAND, FRANCE AND ITALY. WHEN THIS MISSION VISITED AMERICAN AIR SQUADRONS IN FRANCE, IT WAS DISCOVERED THAT OUR PILOTS WERE LOSING WEIGHT, WERE IN POOR PHYSICAL CONDITION AND HAD LOW MORALE. ACCIDENT RATES WERE HIGHER THAN LOSSES FROM ENEMY ACTION. MANY OF THE FLYERS WERE

SUFFERING FROM CONDITIONS ASSOCIATED WITH FLYING WHICH WERE NOT RECOGNIZED OR UNDERSTOOD BY THE MEDICAL OFFICERS ASSIGNED TO THE SQUADRONS, INASMUCH AS THE LATTER HAD RECEIVED NO TRAINING IN AVIATION MEDICINE. TO MAKE MATTERS WORSE, A FLYER WAS NOT PERMITTED TO SEE A MEDICAL OFFICER WITHOUT THE EXPRESS PERMISSION OF HIS COMMANDING OFFICER.

WHEN WORD OF THESE CONDITIONS IN FRANCE WAS RECEIVED IN THE UNITED STATES, PLANS WERE MADE TO TRAIN MEDICAL OFFICERS IN AVIATION MEDICINE. THE "SCHOOL FOR FLIGHT SURGEONS" WAS ESTABLISHED AS A NEW SECTION OF THE AIR SERVICE MEDICAL RESEARCH LABORATORY ON LONG ISLAND. THE SCHOOL WAS NOT READY TO OPEN UNTIL MAY 1919, BUT IN AUGUST 1918, IN RESPONSE TO A CABLED REQUEST FROM GENERAL PERSHING, THIRTY-FOUR OFFICERS AND FIFTEEN ENLISTED MEN WERE DETACHED FROM THE RESEARCH LABORATORY AND SENT TO FRANCE. AS AN INDICATION OF THE ACCOMPLISHMENTS OF THIS FIRST GROUP OF SQUADRON FLIGHT SURGEONS IN A REMARKABLY SHORT TIME IT WAS REPORTED THAT IN SPITE OF THE SHORTENING DAYS AND INCREASING INCLEMENT WEATHER, EXCESS OF FLYING HOURS OVER PREVIOUS RECORDS WERE PER DAY, 22.11; WEEK, 759.03; MONTH, 1,869.47; AND AS OF OCTOBER 15 THERE HAD BEEN THE BEST RECORD OF 4,436.46 FLYING HOURS WITHOUT A SERIOUS ACCIDENT. FOR THE FIRST TIME IN THE HISTORY OF THE AIR FIELDS, THERE WERE SIX HUNDRED PLANES IN COMMISSION. AVIATION MEDICINE MADE A SIGNIFICANT CONTRIBUTION TO THIS IMPROVEMENT IN FLYING CONDITIONS. THUS, AVIATION MEDICINE, BORN OF NECESSITY, RAPIDLY BECAME OF AGE. GENERAL BILLY MITCHELL, AS COMMANDER OF ALL AVIATION ACTIVITIES OF THE AMERICAN EXPEDITIONARY FORCE IN WORLD WAR I, HAD THIS TO SAY: "MY MIND WAS MADE UP MORE THAN EVER TO RELY

ON THE JUDGEMENT OF THE DOCTORS AS TO A MAN'S FITNESS FOR FLIGHT. OUR DOCTORS PROVED THEIR VALUE MORE AND MORE EVERY DAY."

ALTHOUGH THE AIR SERVICE MEDICAL RESEARCH LABORATORY WAS ABANDONED IN 1920, THE "SCHOOL FOR FLIGHT SURGEONS", HAVING MOVED TO MITCHELL FIELD, LONG ISLAND IN NOVEMBER 1919, CONTINUED TO FUNCTION. IT WAS THE POLICY OF THE NAVY TO SEND THEIR NEWLY GRADUATED FLIGHT SURGEONS BACK TO PENSACOLA FOR FLIGHT INSTRUCTION AND PRACTICAL WORK. THIRTY-SIX NAVAL FLIGHT SURGEONS GRADUATED FROM MITCHELL FIELD UNTIL 1926 WHEN THE ARMY MOVED THEIR SCHOOL OF AVIATION MEDICINE TO RANDOLPH FIELD, TEXAS.

INCIDENT TO THE DECLARATION OF A NATIONAL EMERGENCY IN 1939, THE DEMAND FOR A CONSIDERABLE NUMBER OF ADDITIONAL FLIGHT SURGEONS LED TO THE ESTABLISHMENT OF THE NAVAL SCHOOL OF AVIATION MEDICINE AT THE NAVAL AIR STATION, PENSACOLA, ON 20 NOVEMBER 1939. TO DATE, 2,044 NAVAL FLIGHT SURGEONS HAVE BEEN DESIGNATED AND THERE ARE 426 PRACTICING NAVAL FLIGHT SURGEONS ON ACTIVE DUTY TODAY.

AUGMENTING THE FLIGHT SURGEONS ON THE AVIATION MEDICAL TEAM ARE THE AVIATION PHYSIOLOGISTS, THE AVIATION PSYCHOLOGISTS AND THE ENLISTED AVIATION MEDICINE AND AVIATION PHYSIOLOGY TECHNICIANS. THE PRIMARY MISSION OF THIS TEAM IS TO SELECT AND MAINTAIN AT MAXIMUM EFFECTIVENESS PERSONNEL WITH THE CAPABILITY OF PERFORMING A COMPLEX MENTAL TASK IN A HAZARDOUS ENVIRONMENT.

FROM THE BITTER AND COSTLY EXPERIENCE OF OUR ALLIES IN WORLD WAR I, WE LEARNED THE IMPORTANCE OF CAREFUL SELECTION OF OUR

FLYING PERSONNEL. YOU HAVE BEEN THOROUGHLY INTERVIEWED AND RIGIDLY EXAMINED TO ENSURE THAT YOU ARE MENTALLY AND PHYSICALLY QUALIFIED TO ENTER FLIGHT TRAINING AND BECOME SUCCESSFUL NAVAL AVIATORS. THE STANDARDS YOU HAVE MET HAVE BEEN DEVELOPED OVER THE YEARS AND ARE NOW QUITE PRECISE AND DEMANDING. YOU ARE TO BE CONGRATULATED ON PROCEEDING THIS FAR. FOR EACH ONE ACCEPTED IN THE TRAINING PROGRAM, APPROXIMATELY SEVEN HAVE BEEN DROPPED BY VARIOUS SELECTION PROCEDURES.

THE FIRST STEP IN YOUR MEDICAL SELECTION CONSISTED OF THREE AND ONE-HALF HOURS OF PSYCHOLOGICAL TESTING. THESE AVIATION SELECTION TESTS HAVE BEEN USED SUCCESSFULLY IN THE NAVY IN VARIOUS FORMS SINCE 1941 AS A PRINCIPAL PROCEDURE IN DETERMINING WHETHER OR NOT THE CANDIDATE IS AERONAUTICALLY ADAPTED FOR THE RIGORS OF FLIGHT TRAINING AND FOR SUBSEQUENT DUTY WITH THE FLEET. THE DEVELOPMENT AND MAINTENANCE OF THE EFFECTIVENESS OF THESE TESTS HAS BEEN THE RESPONSIBILITY OF A HARD CORE GROUP OF AVIATION PSYCHOLOGISTS IN PROFESSIONAL ASSOCIATION WITH THE FLIGHT SURGEONS.

THE FIRST PART OF THE BATTERY, THE AVIATION QUALIFICATION TEST, IS A TEST OF GENERAL INTELLIGENCE DESIGNED TO PREDICT THE PROBABILITY OF SUCCESS IN GROUND SCHOOL SUBJECTS. THE SECOND PART OF THE BATTERY IS COMPOSED OF THREE SUB-TESTS: THE MECHANICAL COMPREHENSION TEST, SPATIAL APPERCEPTION TEST, AND THE BIOGRAPHICAL INVENTORY. THE COMBINED SCORE FROM THESE THREE PROVIDES A FLIGHT APTITUDE RATING WHICH IS A PREDICTOR OF THE PROBABILITY OF SUCCESS IN THE FLIGHT PHASE OF YOUR TRAINING.

THE VALIDITY AND RELIABILITY OF THESE TESTS WERE ESTABLISHED BY CAREFULLY CONTROLLED STUDIES. BY SCREENING THOSE MOST LIKELY TO FAIL IN FLIGHT TRAINING, SAVINGS OF TWELVE MILLION DOLLARS PER YEAR IN TRAINING COSTS HAVE BEEN REALIZED.

AT THE TIME OF THE SELECTION OF THE ORIGINAL PROJECT MERCURY ASTRONAUTS, IT BECAME OBVIOUS TO OUR AVIATION PSYCHOLOGISTS THAT IT WOULD BE VERY USEFUL TO IDENTIFY INDIVIDUAL AVIATORS WHO POSSESS OUTSTANDING CAPACITIES BEFORE THE PARTICULAR NEED FOR THEM ARISES. SINCE 1960, AVIATION TRAINEES HAVE BEEN SCREENED FOR THEIR INTEREST IN AND THEIR CAPACITY TO MASTER HIGHLY DEMANDING TECHNOLOGICAL ASSIGNMENTS SUCH AS SPACE FLIGHT. TO DATE, A TOTAL OF MORE THAN ONE HUNDRED POTENTIAL PILOTS WITH GOOD TRAINING RECORDS, NAVAL CAREER INTENTIONS, EXCELLENT PHYSICAL CONDITION, AND INTELLECTUAL CAPACITIES EQUAL TO THOSE OF THE MERCURY ASTRONAUTS HAVE BEEN IDENTIFIED. SOME HAVE ALREADY SERVED AS RESEARCH SUBJECTS ON THE HUMAN CENTRIFUGE AT JOHNSVILLE. OTHERS CAN BE CALLED UPON FOR MANY TASKS THAT DEMAND SUPERIOR CAPACITIES. IN ADDITION TO THE IMMEDIATE PRACTICAL VALUE OF KNOWING THE IDENTITY OF OFFICERS WITH OUTSTANDING POTENTIAL, THEIR EARLY IDENTIFICATION PROVIDES AN UNUSUAL OPPORTUNITY FOR LONGITUDINAL STUDY OF THE MEDICAL AND PSYCHOLOGICAL DEVELOPMENT OF SUPERIOR CAREER OFFICERS.

FIFTY PER CENT OF OUR AVIATION CANDIDATES ATTAIN QUALIFYING SCORES ON THE AVIATION PSYCHOLOGICAL SELECTION TESTS AND PROCEED TO THE NEXT STEP IN THE SELECTION PROCESS - THE FLIGHT PHYSICAL EXAMINATION. SINCE 1912, WHEN THE FIRST PHYSICAL REQUIREMENTS FOR

AVIATORS WERE PUBLISHED BY THE NAVY, PHYSICAL STANDARDS HAVE UNDERGONE CONSTANT EVOLUTION AND DEVELOPMENT TO KEEP PACE BOTH WITH THE RAPID ADVANCES IN AIRCRAFT PERFORMANCE AND WITH OUR EXPANDING MEDICAL KNOWLEDGE. IN THE OPERATION TO TODAY'S HIGH PERFORMANCE AIRCRAFT THERE IS NO MARGIN FOR HUMAN ERROR. THE PURPOSE OF THE FLIGHT PHYSICAL EXAMINATION IS TO ENSURE THAT THE INDIVIDUAL EXAMINED IS PHYSICALLY QUALIFIED AND AERONAUTICALLY ADAPTED TO SAFELY AND EFFECTIVELY ACCOMPLISH THE FLYING MISSION.

IN 1940, A STUDY OF 1,056 NAVAL AVIATION CADETS AND FLIGHT INSTRUCTORS WAS CONDUCTED AT PENSACOLA. THE ORIGINAL PURPOSE OF THIS STUDY WAS THE DETERMINATION OF IMPORTANT PHYSIOLOGIC AND PSYCHOLOGIC PARAMETERS IN PILOT SELECTION. RE-EXAMINATIONS OF THIS GROUP WERE CONDUCTED IN 1952 AND 1957 BY TEAMS WHICH TRAVELLED THROUGHOUT THE UNITED STATES EXAMINING THE INDIVIDUALS AT THEIR DUTY STATIONS AND IN THEIR HOMES. IN 1963 EXAMINATIONS OF THE GROUP WERE AGAIN STARTED, THIS TIME BRINGING EACH MAN TO PENSACOLA. HERE A BATTERY OF EXAMINATIONS COVERING LITERALLY ALL ORGAN SYSTEMS HAS BEEN CONDUCTED, WITH PARTICULAR EMPHASIS ON THE CARDIOVASCULAR SYSTEM. ALL DATA FROM THIS AND PREVIOUS EXAMINATIONS HAVE BEEN CODED FOR IBM ANALYSIS. WHERE INDIVIDUALS ARE FOUND TO HAVE SIGNIFICANT DISEASE, A REVIEW OF DATA FROM PREVIOUS EXAMINATIONS MAY REVEAL CLUES WHICH WOULD HAVE PREDICTED THE DISEASE. COMPARISONS BETWEEN FLYING AND NON-FLYING PERSONNEL WERE MADE TO DETERMINE WHETHER THOSE EXPOSED TO STRESSES AND HAZARDS OF FLIGHT ARE MORE SUSCEPTIBLE TO CERTAIN DISEASES. CHANGES WHICH HAVE OCCURRED IN THE VARIOUS TEST FINDINGS AS THE INDIVIDUALS HAVE AGED MAY GIVE INFORMATION AS TO AGING PROCESSES.

NO OTHER STUDY HAS BEEN CONTINUED AS LONG AS THIS ONE. THE INFORMATION BEING DERIVED IS CONTRIBUTING A GREAT DEAL TO OUR KNOWLEDGE OF THE AGING PROCESSES AND TO THE EARLY DIAGNOSIS OF DISEASE. SUCH KNOWLEDGE, IN ADDITION TO ITS VALUE IN ESTABLISHING STANDARDS FOR SELECTION OF INDIVIDUALS FOR FLIGHT TRAINING, MAY RESULT IN ALTERING THE COURSE OF EVENTS TO ENABLE PEOPLE TO LIVE LONGER AND MORE PRODUCTIVELY.

THE PRACTICE OF AVIATION MEDICINE IS NOT CONFINED TO THE DISPENSARY. TO KEEP PACE WITH THE ADVANCES OF AERONAUTICAL ENGINEERING, AVIATION MEDICINE HAS MOVED TO THE COCKPIT, TO THE LABORATORY AND, INDEED, TO THE DRAWING BOARD, THE LATTER TO ENSURE THAT HUMAN FACTORS ARE GIVEN DUE CONSIDERATION IN THE DESIGN OF WEAPON SYSTEMS.

THE SUCCESSFUL PERFORMANCE OF MAN IN THE ENVIRONMENT ALOFT REQUIRES THAT HE BE GIVEN PHYSIOLOGICAL AND MECHANICAL AIDS AND THAT HE BE WELL INDOCTRINATED IN THEIR USE. THE NAVY'S TRADITIONALLY UNIQUE ABILITY TO SUPPORT MAN IN CONFINED AND ISOLATED SPACES AGAINST STRANGE AND HOSTILE ENVIRONMENTS IS A MAJOR FACTOR IN OUR NATION'S PROGRESS TO "CONQUER" SPACE. THE INTEGRATION OF THE PHYSICAL, ENGINEERING AND BIOLOGICAL SCIENCES IN AERONAUTICAL AND SPACE TECHNOLOGIES HAS LED TO A BETTER UNDERSTANDING OF HUMAN PHYSIOLOGY AND PSYCHOLOGY AT HIGH ALTITUDES AND SUPERSONIC SPEED, AND THE EVOLVEMENT OF MECHANICAL DEVICES WHICH ENABLE MAN TO FUNCTION EFFICIENTLY, COMFORTABLY AND SAFELY UNDER TRYING ENVIRONMENTAL CONDITIONS.

THE STRESSES OF MAJOR IMPORTANCE IN MODERN AVIATION ARE

HYPOXIA AND AEROEMBOLISM FROM REDUCED BAROMETRIC PRESSURE; ACCELERATION FROM CHANGES IN VELOCITY; EXTREMES OF TEMPERATURE INCLUDING THE LOW TEMPERATURE OF THE ATMOSPHERE AT ALTITUDE, COLD WATER IMMERSION AND AERODYNAMIC HEATING; VERTIGO AND DISORIENTATION; WEIGHTLESSNESS AND RADIATION IN SPACE TRAVEL; CONFINEMENT; FATIGUE; NOISE; VIBRATION; HIGH INTENSITY LIGHT; AND TOXIC CHEMICALS. THE UNENDING TASK OF THE AVIATION MEDICINE SPECIALISTS FACED WITH THIS MYRIAD OF PROBLEMS IS RESEARCH, DEVELOPMENT, TESTING AND EVALUATION OF PROTECTIVE AND SAFETY EQUIPMENT SUCH AS ANTIBLACKOUT SUITS, OXYGEN SYSTEMS, ANTIEXPOSURE SUITS, PRESSURE SUITS, PARACHUTES, CRASH HELMETS, NOISE PROTECTIVE DEVICES, EJECTION SEATS AND ESCAPE CAPSULES.

IN ORDER TO COMPREHENSIVELY TRAIN NAVAL AVIATORS TO COPE WITH THE HAZARDS OF FLIGHT, AVIATION PHYSIOLOGISTS ARE ASSIGNED TO MAJOR AVIATION ACTIVITIES TO PROVIDE INSTRUCTION IN THE PHYSIOLOGICAL ASPECTS OF THE HIGH ALTITUDE ENVIRONMENT, OXYGEN BREATHING EQUIPMENT, CABIN PRESSURIZATION, AIRBORNE PROTECTIVE AND SURVIVAL EQUIPMENT, NIGHT VISION TECHNIQUES, USE OF THE EJECTION SEAT AND THE FITTING AND OPERATION OF FULL PRESSURE SUITS. PHYSIOLOGICAL TRAINING DEVICES SUCH AS THE LOW PRESSURE CHAMBER, THE EJECTION SEAT TRAINER AND THE NIGHT VISION TRAINER ARE OPERATED UNDER THE SUPERVISION OF THE AVIATION PHYSIOLOGIST. HE CONTRIBUTES TO THE EFFECTIVENESS OF THE AVIATION SAFETY OFFICER'S PROGRAM AT THE SQUADRON LEVEL BY CONTINUOUSLY MONITORING IN-FLIGHT PROCEDURES RELATING TO THE USE OF AIRBORNE PROTECTIVE AND SURVIVAL EQUIPMENT.

AT THIS POINT, I WOULD LIKE TO SUMMARIZE SOME OF THE BIO-MEDICAL RESEARCH, DEVELOPMENT, TESTING AND EVALUATION PROGRAMS DESIGNED TO IMPROVE YOUR EFFECTIVENESS AND PROMOTE SAFETY.

NAVAL SCHOOL OF AVIATION MEDICINE

AT THE NAVAL SCHOOL OF AVIATION MEDICINE HERE IN PENSACOLA, THE BIOPACK WAS DESIGNED WHICH RESULTED IN THE WORLD'S FIRST FLIGHT OF A PRIMATE INTO SPACE AND RECOVERY OF THE ANIMAL ALIVE. THIS WAS THE FAMOUS "ABLE-BAKER" MONKEY BALLISTIC TRAJECTORY FLIGHT CONDUCTED IN COLLABORATION WITH THE ARMY IN 1959. IN THIS FLIGHT, THE NOSE CONE OF THE AEROBEE ROCKET CONTAINED TWO BIOPACKS, THE LARGER CONTAINING THE RHESUS MONKEY, ABLE, AND THE SMALLER THE SQUIRREL MONKEY, BAKER. MISS BAKER'S FLIGHT GAVE OUR RESEARCH SCIENTISTS EARLY KNOWLEDGE OF CAPSULE RECOVERY AND THE MONITORING OF MEDICAL DATA FROM A LIVING BEING IN SPACE AND POINTED THE WAY FOR MANNED SPACE FLIGHT.

CAPTAIN ASHTON GRAYBIEL, MC, USN, DIRECTOR OF RESEARCH AT THE NAVAL SCHOOL OF AVIATION MEDICINE, SERVED AS THE MEDICAL OFFICER IN CHARGE OF PLANNING THE MEDICAL ASPECTS OF THE RECOVERY PHASE OF PROJECT MERCURY. DOCTOR GRAYBIEL IS INTERNATIONALLY KNOWN FOR HIS WORK IN CARDIOLOGY AND IN DISORIENTATION OF HUMAN BEINGS IN AIRCRAFT AND SPACECRAFT.

DOCTOR H. J. SCHAEFER, OF THE SCHOOL STAFF, IS A FOREMOST AUTHORITY ON THE BIOLOGICAL EFFECTS OF COSMIC RADIATION AND IS ENGAGED IN RADIATION MEASUREMENTS FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AND STUDIES ON THE EXPOSURE HAZARDS FROM SOLAR PARTICLE BEAMS WHICH MAN MAY ENCOUNTER ON A MOON FLIGHT.

A UNIQUE FEATURE AT THE SCHOOL IS ITS CAPABILITY FOR STUDYING DISORIENTATION. IN ADDITION TO ENABLING US TO HEAR, THE ORGANS OF THE INNER EAR ASSIST US IN DETERMINING WHETHER WE ARE RIGHT SIDE UP, FALLING, SPINNING, MOVING FORWARD, ACCELERATING, ETC. PILOTS AND ASTRONAUTS ARE SUBJECTED TO INTENSE STIMULATION OF THESE ORGANS. MUCH RESEARCH HAS BEEN DONE AT THE SCHOOL ON THE PRECISE ROLE AND THE FUNCTIONING OF THE ORGANS OF THE INNER EAR. EXPERIMENTS ARE CONDUCTED WITH HUMAN SUBJECTS TO MEASURE THE SMALLEST REACTIONS TO STIMULATION AND TO INVESTIGATE VISUAL ILLUSIONS WHICH MAY ACCOMPANY SUCH STIMULATION AND THE EFFECT OF TUMBLING AS ON THE ASTRONAUT TRAVELING IN SPACE. SOME OF THIS IS DONE ON THE SCHOOL'S HUMAN DISORIENTATION DEVICE, A MACHINE WHICH RESEMBLES A GIANT CEMENT MIXER. IT CONSISTS OF A LARGE CYLINDER IN WHICH THE SUBJECT IS SEATED IN A STANDARD PILOT'S SEAT. THE CYLINDER CAN BE ROTATED IN EITHER ONE OR BOTH OF TWO PLANES SIMULTANEOUSLY. THIS DEVICE HAS PROVED TO BE A VERY EFFICIENT PRODUCER OF DISORIENTATION AND ALLOWS THE STUDY IN DETAIL OF MOVEMENTS WHICH MAN CAN TOLERATE AS WELL AS THE EFFECTS UPON PERFORMANCE UNDER SUCH ADVERSE CONDITIONS.

A SUPPLEMENTARY DEVICE CALLED THE SLOW ROTATING ROOM WAS BUILT TO STUDY THE EFFECTS OF ROTATION IN THE HORIZONTAL PLANE ALONE. THE ROOM IS WINDOWLESS, ABOUT FIFTEEN FEET IN DIAMETER AND IS CAPABLE OF SPEEDS UP TO TWENTY REVOLUTIONS PER MINUTE (AS COMPARED WITH A POSSIBLE SIXTY REVOLUTIONS PER MINUTE OF THE HUMAN DISORIENTATION DEVICE). MUCH OF THIS RESEARCH FOCUSES ON THE POSSIBILITY THAT FUTURE MANNED SPACE STATIONS MIGHT BE BUILT TO SPIN SLOWLY AND CREATE AN ARTIFICIAL FORCE SIMILAR TO THE GRAVITATIONAL FORCE OF THE EARTH.

THIS WOULD COUNTERACT WEIGHTLESSNESS.

DOCTOR D. E. BEISCHER OF THE RESEARCH STAFF IS CURRENTLY INVESTIGATING THE EFFECTS OF HIGH AND LOW MAGNETISM ON LIFE PROCESSES. THE USE OF MAGNETISM AROUND SPACE VEHICLES MIGHT PROTECT THE ASTRONAUT FROM HARMFUL RADIATION. A FACTOR TO BE CONSIDERED IN THE PLANNED MOON FLIGHTS IS THAT THE MAGNETISM OF THE MOON IS LESS THAN 100,000th OF THAT OF THE EARTH.

NAVAL AVIATION MEDICAL ACCELERATION LABORATORY

AT THE NAVAL AVIATION MEDICAL ACCELERATION LABORATORY, JOHNSVILLE, PENNSYLVANIA, THE WORLD'S LARGEST HUMAN CENTRIFUGE HAS BEEN IN SERVICE FOR TWELVE YEARS. IT HAS NOT ONLY BEEN THE PRINCIPAL TOOL IN THE NAVY'S RESEARCH PROGRAM IN ACCELERATION, BUT HAS BEEN USED EXTENSIVELY IN THE X-15,DYNA-SOAR, MERCURY, GEMINI AND APOLLO PROGRAMS. THE OPERATION OF THE CENTRIFUGE BY COMPUTERS PROVIDES NOT ONLY FOR ACCURATE SIMULATIONS OF THE COMPLICATED ACCELERATION PATTERNS ENCOUNTERED IN MODERN AIRCRAFT AND SPACE VEHICLES, BUT ALSO FOR INPUTS FROM THE PILOT'S PERFORMANCE OF ALLOTTED TASKS INTO THE SUBSEQUENT COURSE OF THE FLIGHT. STUDIES ON THE CENTRIFUGE HAVE BEEN INSTRUMENTAL IN DEVELOPING ANTI-G SUITS AND WATER IMMERSION DEVICES TO INCREASE MAN'S TOLERANCE TO ACCELERATION; SIGNIFICANT MODIFICATION IN THE ASTRONAUT'S BODY-MOULDED, SUPINE COUCH; RESTRAINING DEVICES; CONTROL SWITCHES AND FLIGHT PLANS. DYNAMIC FLIGHT SIMULATION ON THE CENTRIFUGE RESULTED IN THE DETECTION OF OVER FIFTY POTENTIALLY FATAL SITUATIONS IN THE X-15 AIRCRAFT.

LAST SUMMER, THE NAVAL AVIATION MEDICAL ACCELERATION LABORATORY CONDUCTED A DYNAMIC SIMULATION AND ASTRONAUT TRAINING PROGRAM IN SUPPORT OF PROJECT GEMINI. THE CURRENT DESIGN OF THE GEMINI COMMAND ASTRONAUT'S CREW STATION AND ITS ASSOCIATED EQUIPMENT WERE INSTALLED IN THE CENTRIFUGE AND THE SEVEN MERCURY ASTRONAUTS AND NINE NEWLY SELECTED GEMINI ASTRONAUTS TESTED AND EVALUATED MANY OF THE CONCEPTS AND HARDWARE.

THIS LABORATORY HAS ALSO DEVELOPED FLAME-RESISTANT CLOTHING FOR PILOTS AND DEVICES TO PROTECT THE EYES OF AVIATORS FROM TEMPORARY BLINDNESS ASSOCIATED WITH UNEXPECTED FLASHES OF BRIGHT LIGHT AS IN ATOMIC EXPLOSIONS. BASIC RESEARCH HAS CONTRIBUTED IMPORTANT LEADS TO THE DEVELOPMENT OF DRUGS THAT MAY PROTECT ASTRONAUTS AGAINST TOXIC EFFECTS FROM IONIZING RADIATION DURING PROLONGED SPACE FLIGHT AND OTHER DRUGS INTENDED TO IMPROVE MAN'S PERFORMANCE UNDER STRESS.

AEROSPACE CREW EQUIPMENT LABORATORY

THE AEROSPACE CREW EQUIPMENT LABORATORY AT PHILADELPHIA, UNDER VARIOUS NAMES, HAS EXISTED SINCE JANUARY 1942 WHEN IT WAS ORGANIZED FOR THE EVALUATION OF OXYGEN EQUIPMENT AND FLIGHT CLOTHING. SUCH THINGS AS OXYGEN MASKS AND REGULATORS, IMMERSION SUITS, FULL PRESSURE SUITS, PROTECTIVE HELMETS, RESTRAINT APPARATUS, EJECTION SEAT EQUIPMENT AND CRASH PROTECTION EQUIPMENT HAVE BEEN DESIGNED AND DEVELOPED IN THIS LABORATORY.

TO RELATE THE DEVELOPMENT OF ANY ONE OF THESE ITEMS OF HARDWARE WOULD BE A LENGTHY STORY. BY THE END OF WORLD WAR I, PLANES

WERE CAPABLE OF REACHING AN ALTITUDE OF 25,000 FEET. AT THAT TIME THE DREYER OXYGEN SYSTEM, BORROWED FROM THE BRITISH WAS ADOPTED. THIS APPARATUS INCLUDED A SMALL TANK IN WHICH OXYGEN WAS STORED UNDER PRESSURE OF 2,250 POUNDS PER SQUARE INCH; A PRESSURE REDUCING VALVE PROVIDING FINAL PRESSURE OF THREE POUNDS. THE PILOT MERELY TURNED IT ON OR OFF, THIS SYSTEM BEING FULLY AUTOMATIC. AS PLANES FLEW HIGHER, SEVERAL CHANGES IN OXYGEN SYSTEMS ENSUED. THE DILUTER-DEMAND OXYGEN REGULATOR PROTECTED THE PILOT UP TO 35,000 FEET. LIQUID OXYGEN SYSTEMS REPLACED THE OLDER GASEOUS SYSTEMS PROVIDING A LARGER SUPPLY OF OXYGEN WITH LESS WEIGHT PENALTY. POSITIVE PRESSURE REGULATORS INCREASED THE PILOT'S CEILING TO 43,000 FEET. A NEW MINIATURE REGULATOR WAS DESIGNED WHICH MOUNTED ON THE MAN INSTEAD OF THE AIRFRAME AUTOMATICALLY CONNECTED TO THE BAILOUT OXYGEN SYSTEM IN CASE OF EJECTION. IN CASE OF SUBMERSION, THIS SYSTEM WILL ALSO PROVIDE THE AVIATOR WITH BAILOUT OXYGEN UNDER WATER. AS AIRCRAFT CEILINGS EXCEEDED 40,000 FEET, CABIN PRESSURIZATION AND THE FULL PRESSURE SUIT WERE DEVELOPED. FOR PROLONGED SPACE FLIGHTS, WHEN THE WEIGHT PENALTY OF OXYGEN STORAGE WOULD BE PROHIBITIVE, THE USE OF A CHEMICAL SOURCE OF OXYGEN SUCH AS THE SUPEROXIDES IS BEING STUDIED AS ARE CLOSED ECOLOGICAL SYSTEMS USING SUCH SIMPLE PLANTS AS ALGAE AS AN OXYGEN SOURCE.

AT THE AEROSPACE CREW EQUIPMENT LABORATORY, THE NAVY'S FULL PRESSURE SUIT WAS DEVELOPED UNDER THE DIRECTION OF NAVY FLIGHT SURGEONS. THIS SUIT WAS DESIGNED TO GIVE PRESSURE PROTECTION, OXYGEN, COOLING AND VENTILATION, AND INSULATION IN COLD WATER AND SURVIVAL

SITUATIONS. IT IS USED IN ALL CURRENT NAVY HIGH ALTITUDE AIRCRAFT ABOVE 45,000 FEET. THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION SELECTED THIS NAVY DEVELOPED SUIT FOR THE PROJECT MERCURY ASTRONAUTS. ALSO, THE AIR FORCE, WHICH DEVELOPED A PARTIAL PRESSURE SUIT, NOW USES THE FULL PRESSURE SUIT BECAUSE OF THE MORE ADEQUATE PROTECTION PROVIDED.

THE VERTICAL EJECTION TOWER AT THE AEROSPACE CREW EQUIPMENT LABORATORY, 150 FEET IN HEIGHT, IS USED TO DEVELOP AND EVALUATE EJECTION SEAT SYSTEMS, ENERGY ABSORPTION CUSHIONS AND PILOT RESTRAINT CONFIGURATIONS. ON THIS TOWER, STARTING IN 1946, NAVY FLIGHT SURGEONS EVALUATED THE FIRST NAVY EJECTION SEAT. THE FLIGHT SURGEON TESTING THE FIRST SEAT BROKE HIS BACK AND AS A RESULT THE EJECTION CHARGE WAS REDUCED.

OTHER WORK AT THIS LABORATORY HAS INCLUDED: USE OF A HORIZONTAL ACCELERATOR TO DEVELOP 40 G SEAT PROTECTION; DEVELOPMENT OF HELMETS TO PROTECT AGAINST INJURIES; DEVELOPMENT OF THE ANTIEXPOSURE SUIT TO PROTECT THE PILOT AGAINST COLD WATER IMMERSION UPON DITCHING OR BAILOUT; STUDIES OF UNDERWATER EJECTIONS FROM AIRCRAFT COCKPITS IN A TANK DESIGNED FOR THIS PURPOSE; COCKPIT LIGHTING AND HUMAN ENGINEERING STUDIES OF COCKPIT CONTROLS AND INSTRUMENTS.

NAVAL MEDICAL RESEARCH INSTITUTE

THE NAVAL MEDICAL RESEARCH INSTITUTE AT BETHESDA HAS CONDUCTED SIGNIFICANT RESEARCH IN AVIATION MEDICINE SINCE 1942 AS ONE OF ITS TASK ASSIGNMENTS. MORE THAN ONE HUNDRED REPORTS OF

COMPLETED RESEARCH HAVE BEEN PUBLISHED ON SUCH DIVERSE SUBJECTS AS PERSONAL SURVIVAL EQUIPMENT; MECHANICAL SAFETY EQUIPMENT; VISION AND RETINAL BURNS; TRAINING AND PERFORMANCE OF PILOTS UNDER STRESS; CARBON MONOXIDE PROBLEMS, NOISE AND VIBRATION; AND MEDICAL HAZARDS ASSOCIATED WITH THE USE OF LASERS.

SHORTLY AFTER WORLD WAR II, PROJECT RAM (RESEARCH IN AVIATION MEDICINE) WAS ESTABLISHED. THIS PROJECT PROVIDED A FLYING LABORATORY IN THE FORM OF A SPECIALLY MODIFIED C-54 (R5D) BASED AT ANACOSTIA. THE NAVAL MEDICAL RESEARCH INSTITUTE, UTILIZING THIS FLYING LABORATORY, BEGAN INVESTIGATIONS ON HUMAN FACTORS AFFECTING OPERATIONAL PERFORMANCE AND THE TRANSMISSION OF PHYSIOLOGICAL DATA FROM AIR TO GROUND BY ELECTRONIC METHODS. IN 1954, THE FIRST PHYSIOLOGICAL DATA TELEMETERED IN THIS COUNTRY FROM A PILOT IN AN AIRCRAFT TO A GROUND STATION WAS ACCOMPLISHED BY THIS LABORATORY. AMONG THE DATA TELEMETERED WERE CONTINUOUS RECORDS OF THE HEART (EKG), BRAIN (EEG), RESPIRATORY RATE AND TEMPERATURE. WHEN THE STRATO-LAB BALLOON FLIGHTS WERE INAUGERATED BY THE NAVY TO STUDY ATMOSPHERIC CONDITIONS AT VERY HIGH ALTITUDES AS WELL AS THE PHENOMENA BEYOND, MONITORING OF THE CONDITION OF THE CREW IN THE GONDOLA FROM THE GROUND WAS A CONSTANT FEATURE OF EACH FLIGHT. ON ONE OCCASION, A FLIGHT SURGEON ON THE GROUND NOTING AN UNUSUAL CONDITION IN THE TELEMETERED OXYGEN SYSTEM CONTROLS ORDERED THE BALLOON TO DESCEND. FORTUNATELY, THE CREW IN THE GONDOLA REACHED A LEVEL LOW ENOUGH TO BREATHE WITHOUT THEIR OXYGEN MASKS, FOR THEIR SUPPLY HAD DIMINISHED TO APPROXIMATELY TWO MINUTES DUE TO A FAULTY REGULATOR. THE SIGNIFICANCE OF THIS EARLY WORK IN RELATION TO SUBSEQUENT MANNED SPACE FLIGHT IS READILY APPARENT.

USE OF THESE TECHNIQUES PIONEERED AT THE NAVAL MEDICAL RESEARCH INSTITUTE PERMITTED FLIGHT SURGEONS POSITIONED AT STRATEGICALLY LOCATED STATIONS AROUND THE WORLD TO CONSTANTLY MONITOR THE PHYSICAL CONDITION OF THE ORBITING ASTRONAUTS.

AT THE NAVAL AIR TEST CENTER, PATUXENT RIVER, MARYLAND, THE AERO MEDICAL BRANCH IS CONCERNED WITH THE EVALUATION OF PERSONNEL SAFETY GEAR AND THOSE ITEMS IN THE COCKPIT WHICH RELATE TO THE EFFECTIVENESS OF THE PILOT AND AIRCREWMEN ALOFT.

AT THE NAVAL PARACHUTE FACILITY, EL CENTRO, CALIFORNIA, EFFORTS ARE CONCENTRATED ON THE DEVELOPMENT OF PARACHUTES, PARACHUTE HARNESSES, SURVIVAL KITS AND LIFE VESTS.

TO ADEQUATELY COVER RESEARCH AND DEVELOPMENT IN THE FIELD OF AVIATION MEDICINE WOULD TAKE WEEKS. ITS MAIN PURPOSE IS TO PROMOTE THE SAFETY AND EFFECTIVE PERFORMANCE OF THE HUMAN OPERATOR.

THE NAVAL AVIATOR IS CAREFULLY SELECTED, HIGHLY EDUCATED AND EXTENSIVELY TRAINED. YOUR WELL-BEING, SAFETY, PHYSICAL AND PSYCHOLOGICAL FITNESS ARE OF PARTICULAR CONCERN TO THE BUREAU OF MEDICINE AND SURGERY. TO THIS END, WE CONTINUALLY TRAIN DOCTORS IN AVIATION MEDICINE, DESIGNATING THEM AS NAVAL FLIGHT SURGEONS. REGARD THE FLIGHT SURGEON AS YOUR FRIEND. GO TO HIM WITH YOUR PERSONAL OR FAMILY PROBLEMS IN CONFIDENCE. HE WILL KEEP FAITH WITH YOU.